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RELIABILITY BASED DESIGN OPTIMIZATION BY USING METAMODELS

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Abstract: This paper summarize my work so far on reliability based design optimization (RBDO) by using metamodels and present some new ideas on RBDO using support vector machines. Design optimization of complex models, such as non-linear finite element models, are treated by fitting metamodels to computer experiments. A new approach for radial basis function networks (RBFN) using a priori bias is suggested and compared to established RBFN, Kriging, polynomial chaos expansion, support vector machines (SVM), support vector regression (SVR), and least square SVM and SVR. Different types of computer experiments are also investigated such as e.g. S-optimal design of experiments, Halton- and Hammersley sampling, and different adaptive sampling approaches. For instance, SVM-supported sampling is suggested in order to improve the limit surface by putting extra sampling points at the margin of the SVM. Uncertainties in design variables and parameters are included in the design optimization by FORM- and SORM-based RBDO. By establishing the most probable point (MPP) at the limit surface using a Newton method with an inexact Jacobian, Taylor expansions of the metamodels are done at the MPP using intermediate variables defined by the iso-probabilistic transformation for several density distributions such as lognormal, gamma, Gumbel and Weibull. In such manner, LP- and QP-problems are derived which are solved in sequence until convergence. The implementation of the approaches in an in-house toolbox are very robust and efficient. This is demonstrated by solving several examples for a large number of variables and reliability constraints.